City of Memphis
Maynard C. Stiles Wastewater Treatment Plant
Disinfection Improvements

Pilot Study Work Plan Summary
December 2014

Pilot Objective
The objective of the full-scale pilot study is to identify the best disinfection control strategy to achieve compliance with the future National Permit Discharge Elimination System (NPDES) permit disinfection limits under varying flows and influent quality conditions using peracetic acid (PAA).

Dose Control Strategy
The pilot will be conducted in four phases that will include development of information on the best means of providing dose control. A fifth phase will be used to demonstrate the efficacy of the final process control algorithm. Data collected during the pilot will be used to inform the final design of the dose control for the full-scale system design:

Phase 1: Assessment of Influent Quality Indicators
During this phase, four (4) influent quality indicator candidates will be evaluated with the objective of selecting two parameters that could be tested at full scale in a feed-forward process control strategy. The four indicator candidates are:

- Chemical Oxygen Demand, COD
- Color, PtCo Units
- UV Transmittance @ 254nm, UVT
- Oxidation/Reduction Potential, ORP

During Phase 1, indicator candidates will be measured continuously on-line for a period of two (2) weeks, assuming at least one PAA demand peak will be observed during this period. PAA will be fed at a constant dose using a simple flow pacing controller to account for changes in plant flow rate.

Phase 2: Evaluation of Feed Forward Control Strategy with Indicator Candidate A
During this phase, the disinfectant dose will be automatically controlled based on flow (flow pacing) and the best influent quality indicator from Phase 1 (demand pacing, assuming that at least one PAA demand peak will be observed during this period.

Phase 3: Evaluation of Feed Forward Control Strategy with Indicator Candidate B
During this phase, the disinfectant dose will be automatically controlled based on flow (flow pacing) and the second best influent quality indicator from Phase 1 (demand pacing), assuming that at least one PAA demand peak will be observed during this period.

Phase 4: Data Collection for Calibration of Set Point Values
Data from Phases 2 and 3 will be compared to select the best performing process control strategy (most precise control of dose in response to flow and demand changes). The selected control strategy will be run during Phase 4 to perform model calibration (adjusting coefficients of control algorithm) and definition of process control set points.

Phase 5: Process Demonstration

A final process demonstration will be conducted during Phase 5, collecting field data to demonstrate compliance with daily maximum and monthly average disinfection criteria as well as maximum effluent PAA residual limit (2 ppm) specified in the NPDES permit. During this phase, the dosing of PAA will be automatically controlled based on both flow and demand pacing.

Data Analysis

Regression analysis will be used to determine the best fit among the water quality parameters, PAA residual and microbial reductions to determine the best parameters for process control. The best correlation (as determined by regression analysis) will be selected by considering the lowest deviation in the curve fit and the steepest slope that would provide the greatest sensitivity for process control. The demonstration system will then use a feed-forward loop with the selected parameter, along with flow-pacing and feed-back from the PAA residual analyzer at the discharge. The control system is being optimized for performance for each of these two water quality control parameters.

Pilot Study Management

The pilot is a collaborative effort among the City of Memphis, PeroxyChem and CDM Smith. The City has contracts with CDM Smith and PeroxyChem to implement the study. PeroxyChem is providing chemical, feed equipment, and staff to run the system; PeroxyChem will also be providing data collection and initial data analysis. CDM Smith is providing technical oversight and design services for the pilot project.

Additional Industrial User Testing

Additional evaluation will be conducted on water quality parameters that were previously identified to be related to the disinfectant chemical oxidant demand at the Stiles wastewater treatment plant (WWTP) as they relate to industrial discharges to the WWTP. CDM Smith is currently working with the City to develop a sampling plan for collection and analysis of samples from industrial dischargers. Results of the industrial sampling will be evaluated with the full-scale PAA pilot data to determine which parameter is best correlated with PAA chemical demand.